SCIENCE

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THE SOUTH DAKOTA ARTESIAN BASIN.

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THE State of South Dakota is about 320 miles long by 210 miles wide. The Missouri River crosses the middle of the north boundary and flows south-southeast till it reaches the north boundary of Nebraska, when it sweeps around to the east and forms the boundary line between South Dakota and Nebraska. Five great water-courses pass down the long slope of the high plains from the western boundary of the State to the Missouri River. The largest of these is the Cheyenne River, furnishing a drainage channel for the Black Hills, which lie partly in South Dakota and partly in Wyoming. A few small, short streams flow from the east into the Missouri. The James River (formerly called Dakota River) flows in a very direct course, south by east, across the State, bisecting the part of the State east of the Missouri River. The James River valley is a broad plain fron 1,200 feet to 1,300 feet above sea-level. As early as 1882 artesian wells were drilled at different places in the valley with the hope of securing a more abundant supply for the cities and villages which were so rapidly outgrowing their water-supply.

The uniform success in getting water, the abundant supply, the good quality, and the great force with which it was ejected began to attract general attention. It has been demonstrated by numerous and widely-distributed experiments that the whole James River valley is an artesian basin. Geologists and engineers seem to agree that it is the most wonderful artesian basin in the world. The source and limit of the water-supply of this region have been the subject of careful and extended investigations by both Federal and State commissions. In this brief paper the writer will endeavor to give the results of these investigations to date.

1. The source of the supply of water.

There are three general requirements that must be satisfied in seeking for the source of supply of an artesian basin: —

I. The source must be as high as the greatest height to which the water, in any well tapping the basin, will rise.

II. The amount of rainfall on the source-area must be adequate to account for the supply of the basin.

III. The geological formations between the source and the basin must be such as to allow the passage of the water through a pervious stratum between two impervious strata.

Several theories exist as to the source of the supply in the basin in question: (*a*) The Great Lakes; (*b*) the Canadian lakes; (*c*) Devil's Lake, North Dakota; (*d*) the Missouri River; (*e*) the elevated region west of the Missouri River, including the foot-hills and the east slope of the Rocky Mountains.

Let us apply the three requirements stated above to the regions just named.

The height to which the water of the Redfield, South Dakota, well would rise, if the tube were extended, is 1,700 feet A. T.[1] There are other wells north and west of Redfield whose water would rise to a greater height.[1] The well at Highmore has a flow of nine gallons and a pressure of twelve pounds at an altitude of 1,890 feet.[2] But the altitude of the Great Lakes and of the Canadian lakes is many hundred feet below that height.[3] The altitude of Devil's Lake is about 1,440 feet,[1] and the altitude of the Missouri River where it enters South Dakota is not over 1,500 feet.[3]

It therefore follows that neither the Great Lakes, the Canadian lakes, nor Devil's Lake can be the source. Nor can the Missouri River within the State be the source. We are now confined to our last alternative,—the elevated region west of the Missouri River,—which may, for convenience, be considered under two heads: (1) The High Plains, and (2) The Foot-Hills of the Rockies. (1) The high plains attain an altitude of 1,900 feet about 50 miles west of the Missouri River.[4] They satisfy requirement I.

An idea of the water-supply of an artesian basin can be gotten only by finding the amount of water that can be drawn off without lessening the flow and pressure of individual wells. W. P. Butler, engineer of Aberdeen, South Dakota, under date of June, 1892, says that "two hundred wells have already been put down in North and South Dakota."[5] The same engineer gives a "Table of twenty-four South Dakota wells showing flow in gallons per minute."[6] The range of discharge, as shown by this table, is from 150 gallons to 7,000 gallons per minute; the intermediate points seem to be sufficiently represented to indicate that the table is fairly representative. Taking this table as a basis, the average flow of a South Dakota artesian well is 1,655 gallons per minute. Two hundred wells would, at that rate, discharge 685 million tons per annum. No diminution in the pressure of any of the wells has been detected. The limit has, therefore, not yet been approached. Now many times the amount annually discharged by the South Dakota artesian wells falls each year upon the high plains (region *e*, 1) west of the Missouri River in South Dakota; but the rapid evaporation from the surface, the ready drainage into the Missouri River, and the impervious shales beneath the surface preclude the possibility of the high-plain rainfall taking any appreciable part in the water-supply of the basin. Driven now to our last alternative, let us apply our three tests in succession.

I. The elevation of the foot-hills varies from 3,000 feet to 8,000 feet above sea-level, which is certainly sufficient altitude above the James River valley to overcome the resistance and give the wells a high pressure 240 to 600 miles away.

II. The annual rainfall in the foot-hills is greater per given area than on the high plains.[7]

The area of the foot-hills, whose rainfall can get access to the water-bearing rocks, is not far from 40,000 square miles, upon which area not less than 69,600 million tons of water fall per annum, which is one hundred times as much as that drawn annually from the artesian basin of the Dakotas.

III. The geological formation between the Black Hills and the James River valley is well shown by the accompanying figure.[8]

A glance at this figure will show that water entering the porous Dakota sandstone above Rapid City will produce the conditions for an artesian flow in the region of the James River and the Missouri River. The lower altitude of the former will make the flow stronger there, even though it be farther away from the source. The increasing altitude as one goes west from the Missouri River will undoubtedly decrease or wholly prevent a flow. Any geological section taken across the Dakotas from east to west would be similar to the one shown. Wherever the section would pass through foot-hills or mountain ranges the upturned edges of the absorbing strata would crop out.

The three requirements being satisfied by the last region tested, it has been demonstrated beyond a shadow of doubt that the source of the water-supply of the James River artesian basin is

1 "Artesian and Underflow Investigation," Part II., Col. E. S. Nettleton, Chief Engineer. Appendices XVIII., XIX., and XX.

2 "Artesian and Underground Investigation," Part IV., F. B. Coffin, Engineer for South Dakota.

3 American Geological Railroad Guide. Macfarlane.

4 "Artesian and Underflow Investigation," Part IV., F. B. Coffin.

5 Irrigation Manual. W. P. B. p. 9.

6 Irrigation Manual. W. P. B. p. 38.

7 Irrigation Manual, W. P. Butler, p. 94, "On the high plain the rainfall is 15 to 20 inches, while in the Black Hills it is 20 to 30 inches per annum."

8 "Irrigation and Underflow Investigation," Part III., Special Report by Professor G. E. Culver, State Geologist.

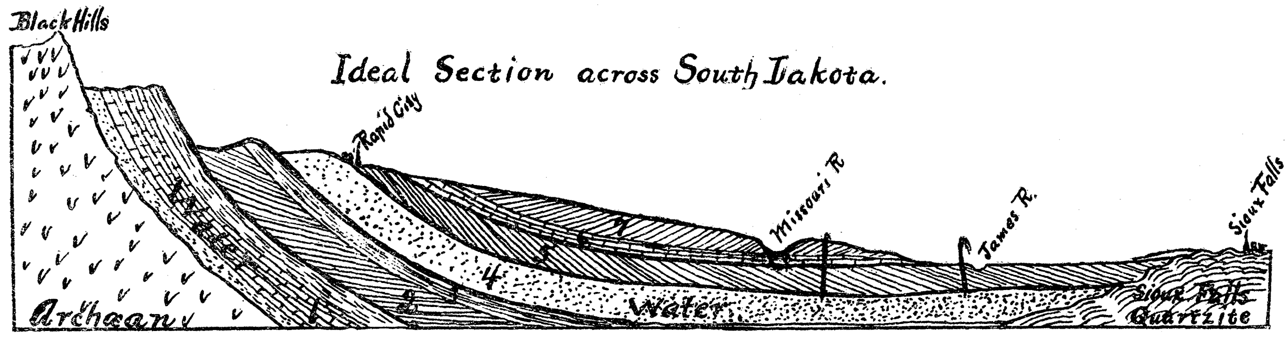
the elevated, well-watered hills and low mountains, together with the east slope of the Rockies in South Dakota, Montana, and Wyoming.

2. The limitations of the supply.

It was estimated that about 69,600 million tons of water fall annually on the foot-hills within this drainage basin. Having limited the source to the foot-hills, it is clear that the limitations can be carried further. The water flowing through the Dakota sandstone must either (*a*) have fallen directly upon the area of outcrop, or (*b*) have sunk into it from streams flowing over it, or (*c*) have escaped into it at high altitudes from other strata.

(*a*) It is estimated by Professor G. E. Culver[1] that about $\frac{1}{72}$ of the rainfall of the Black Hills falls directly upon the outcropping Dakota sandstone. If this outcrop forms the same proportion of other foot-hills, then about 966 million tons per annum would fall directly upon this; and, as it is estimated that one-third of the rain-fall is absorbed by the soil, 322 million tons would be poured directly into the artesian basin.

(*b*) As far as the writer knows, but one stream has been carefully studied as to the quantity of water lost to the stratum in question. Below Great Falls, Montana, the Missouri River flows across the outcropping Dakota sandstone at an altitude of 2,800 feet. Col. E. S. Nettleton[2] made careful gaugings of the river before and after crossing the sandstone and found that it lost "834 cubic feet per second," which would amount to 918 million tons per annum. The Yellowstone River, which is about as large



Length of Section, 385 miles. Rapid City to James River Valley, 230 miles.

1, Paleozoic rocks, mostly water-bearing Carboniferous limestone; 2, Triassic shales, impervious; 3, Jurassic shales, impervious; 4, Cretaceous, Dakota sandstone, water-bearing; 5, Cretaceous, Benton shales, impervious; 6, Cretaceous, Niobrara limestone; 7, Cretaceous, Pierre shales, impervious.

as the Missouri above their confluence, is said to flow across the Dakota sandstone and to lose a part of its volume. It is generally true that all streams flowing out of the foot-hills or away from the Rockies must, somewhere in their eastward course, cross the absorbing stratum. To estimate three times 918 million tons as the amount received from source (*b*) will probably fall much within the limits. That gives us an aggregate from (*a*) and (*b*) of 3,076 million tons per annum.

(*c*) The outcrop of the Carboniferous forms a much larger part of the foot-hills area than does the Dakota. At least one-third of the water which falls directly upon it sinks, while nearly all of the small streams flowing out of the central Archæan area of the hills sink completely into the Carboniferous, only a few of the largest streams emerge from the thirsty Carboniferous area. The amount of water entering the Carboniferous strata is many times greater than that entering the Dakota. Now it is possible for nearly all of the water which it absorbs to escape into the Dakota, which it would do anywhere between its source and the James River valley if either one of two things were true: (1) If the overlying stratum "pinches out," or (2) if it is fractured or faulted. Both, one, or neither of these things may be true. No one has yet attempted to answer, conclusively, the question, "What becomes of the water which sinks into the Carboniferous limestone of the hills?" Until that question is answered, it will be impossible to determine the limitations of the water-supply of the artesian basin.

[1] "Artesian and Underflow Investigation," Part III., p. 207.

[2] "Artesian and Underfl w Investigation," Part II., p. 77.

A ROW OF HIEROGLYPHS, CASA NO. 2, PALENQUE.

BY H. T. CRESSON, A.M., M.D., PHILADELPHIA, PA.

THERE is a perpendicular row of three glyphs just above the child-like figure, upheld in the arms of the *Ahkin* (?), on the centre slab of the so-called "Group of the Cross," Casa No. 2, (Stephens), Palenque, and two hieroglyphs in the parallel line to the right of the perpendicular line just mentioned, which are exceedingly interesting, and all of them, except the upper-centre component of the glyph, just above the child-like figure, are in a fair state of preservation. The upper centre component of this glyph (Fig. 6) has been badly injured, if we may judge by a photograph of the slab from Casa No. 2, taken by Dr. Manuel Urbino, the learned conservator of the Muséo Nacional, at the City of Mexico It is a lucky circumstance that this masterpiece of the Maya scribe-sculptor's art has been cared for by the Mexican government, and it is to be hoped that they will protect other tablets at Palenque from the wanton destruction of the Mayas, who have been accused, by recent explorers, of chopping to pieces, with their *machetes*, the artistic productions of their ancestors.

It will be impossible, in this necessarily brief article, to consider the entire row of glyphs which have been indicated, we will, therefore, confine our remarks to that shown in Fig. 6 of the plate. If we compare this sketch, made from a photograph of the middle slab of the cross group (Casa No. 2, Palenque), taken by Dr. Urbino, it will be seen that it differs in certain respects from the drawing of Del Rio, Waldeck, Catherwood, and Charnay. Del Rio's rendition of this hieroglyph (Fig. 1) is absurdly incorrect, and has been suggested, we think, either by a slovenly impression of the centre bar of a cross (see Waldeck's Fig. 2), or else the artist drew upon his imagination and supplied the detail.

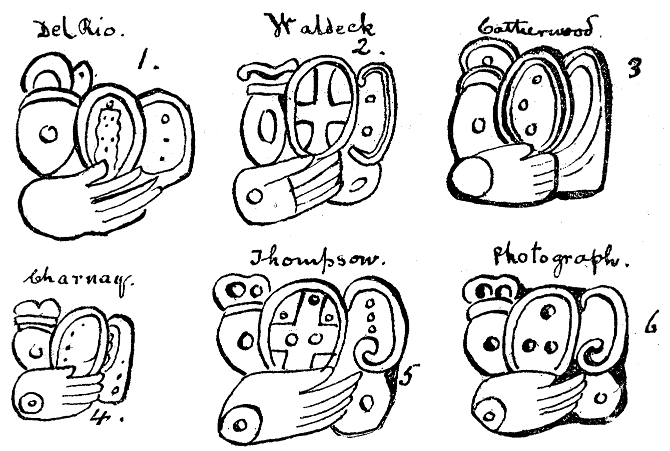
Waldeck's drawing (Fig. 2) in four of the small glyphs (composing the compound glyph) is not so far astray as one might expect, judging by the way his drawings have been condemned by some writers, and I find that in the perpendicular and the parallel row of glyphs of the Casa No. 2 tablet, to the right of the symbol of the days, four winds, and cardinal points (called by many the Cross), his work compares quite as well with the photograph as that of Charnay, who used the camera, and Catherwood, who used the camera lucida. So far as I can learn, Mr. Waldeck used no artificial aids to assist him in his work (?); if this be the case, his eye must have been an unusually correct one, considering the amount of work he accomplished, and the confusing details that he encountered, to say nothing of annoyances in the way of flies, mosquitoes, garapatas, and other insects. I think the truth of this assertion will be apparent to anyone who has attempted to make a careful drawing under difficulties of this kind, especially such intricate details as we find in ancient Maya architecture and hieroglyphs, well calculated to give an experienced draftsman the headache and heartache. The centre-upper component of the hieroglyph, drawn by Waldeck, differs from that of Fig. 6, but I must not neglect to mention that the Urbino photograph indicates that this component of the glyph has been so injured that it is difficult, at present, to determine the details. The round incisions

are apparent, as in Fig. 6. but they differ slightly in their position when compared with Catherwood (Fig. 3).

Stephens mentions that, at times, those engaged in commercial ventures have reached Santo Domingo del Palenque, and proceeded thence to the ancient Maya ruins, called, for want of a better name, Palenque, after the village near which they stand.

We have represented in Fig. 5 a sketch made by Mr. William Robert Thompson, who visited the ruins of Palenque in December, 1852, and again at a later date. Engaged in commercial pursuits in northern Chiapas and other parts of Mexico and Guatemala, Mr. Thompson has examined many of the old Maya cities, especially Qurigia and Palenque, sketching, in leisure moments, such details as he found interesting, preserving them for his own gratification. In looking over his portfolio some years ago I was struck with the resemblance of his drawing (Fig. 5) to that of Waldeck (Fig. 2). Mr. Thompson having returned to Mexico, I wrote to him in 1882 requesting a copy of his sketch, and, with all due courtesy, he presented me with the original, accompanying it with an autograph letter. The letter and sketch I shall forward to the American Philosophical Society of Philadelphia, so that they can be preserved for future examination.

Comparing the Thompson sketch with that of Mr. Waldeck, it will be seen that the latter has omitted the small incised circles which are present in the former, on the bar of the cross and at its top and sides, which Mr. Thompson's letter especially mentions as present. Waldeck, in the cross-like glyph, to the right, gives



two small circles as its components, and Thompson gives three, which Charnay also indicates in Fig. 5, while both he and Catherwood omit the small round glyph with the incised circle, which is shown at the lower right-hand side in the Urbino photograph (Fig. 6), also in the sketches of Waldeck and Thompson. It is not surprising that so careful a draftsman as Catherwood should have omitted details in drawing this glyph, ill as he was with fever and subjected to annoyances which only those who have encountered them can appreciate.

All of the drawings of this (Fig. 6) glyph differ more or less; those of Waldeck and Thompson have four of the small glyphs represented with a fair degree of exactitude, accepting the photograph as our standard; Catherwood and Charnay have three details of the compound glyph which are, in a measure, correct. The fact that Messrs. Waldeck and Thompson both give a symbol resembling the symbol of the cardinal points as a component of the glyph which we are considering, suggests a probability that it existed and has been effaced. The surface of the glyph at present being so mutilated it would be best to examine the original tablet with care before deciding the matter, which I hope someone interested in palæography will have the opportunity of doing in the near future. The position of the three small circles in Fig. 6 correspond with the Thompson sketch (Fig. 5), even if the cross is absent, and, as Thompson gives an incised circle to either side of the cross at the top, it is not improbable that a series of dotted lines, or circles, at one time ran completely around the glyph, as we see a slight suggestion of this in Charnay's sketch (Fig. 4), and also in Catherwood's Fig. 3. Mr. Thompson asserts, positively, in his letter, that a cross did exist, and that the three incised circles were present on its perpendicular and parallel bars. He has, in a recent conversation upon the subject, expressed the belief that this symbol of the winds has been mutilated intentionally, and that the two circles at the sides of the perpendicular bar are quite recent additions, made by someone trying to alter the glyph into the semblance of a face. Two small circles on either side suggest the eyes, and the upper portion of the perpendicular upright above being mutilated across, just beyond its point of junction with the parallel bar, thus produces a semblance to a nose, the parallel bar assuming somewhat the appearance of a mouth. This seems to be the case in the small Urbino photograph, but in the enlarged copy the mutilation of the glyph is more apparent, yet, as we have suggested, these matters can only be decided upon by a careful study of the original tablet.

A realistic drawing of the upper-centre component of this hieroglyph would be of great value for comparison with the photograph, as there are some details which the camera does not reproduce. If some of our artists visiting the Muséo Nacional, at the City of Mexico, would make a careful drawing of the Casa No. 2 tablet, it would be of great value to those engaged in the study of Maya palæography, and no doubt determine the question whether a cross and its dots (Fig. 5) are to be accepted as the true components of the glyph, or the details given in Fig. 6 of the plate accompanying this article. Until these doubts be settled, attempts at its interpretation are useless.

THE OSAGE RIVER AND ITS MEANDERS.

BY ARTHUR WINSLOW, OFFICE OF THE GEOLOGICAL SURVEY, JEFFERSON CITY, MO.

IN the remarks upon the Osage River in Missouri, which form part of his admirable notice of the topographic maps of the U. S. Geological Survey, published in *Science* of April 28, 1893, Professor Davis has, with great acumen, hit upon one of the most noticeable features of the drainage of the State, or, at least, of the southern part. The peculiar meandering of the deeply trenched Osage Valley around spurs of high upland country, as referred to by us in a recent report of the Geological Survey,[1] is a feature shared by nearly all of the principal streams of the Ozark region. The Meramec and the Gasconade Rivers, the Big Piney and the Bourbeuse Creeks of the northern slope have the same swinging course; as have also their tributaries and those of the Osage itself. White River, on the southern slope, in Missouri and Arkansas, is characterized by similar convolutions. The courses of Big River and of the St. Francois River in the southeast have a like aspect. In strong contrast to this are the streams of that portion of the State lying north of the Missouri River—the drift-covered area. Here the courses are, in a general way, straight, often parallel in groups, the meanders of the streams confined to their present flood plains; their channels apparently having originated in the mantle of glacial drift. They are comparatively of recent origin, the older drainage system which lies masked beneath the drift may have been more tortuous.

The suggestive explanation which Professor Davis offers for the sunken curved course of the Osage, i e., that it has been developed, through elevation and corrosion, from the flood-plain meanders of the stream, originating during an earlier base-leveled condition of the country, seems a natural explanation and is in many respects satisfactory. Still we hesitate to accept it in the present stage of our knowledge on mere *a priori* grounds. We see that it calls for a previous base-leveling of the whole Missouri-Ozark region, if not of the contiguous or even remoter Arkansas territory. Further, the hypothesis has so intimate a bearing upon the problems of recent geologic history of this country, over and above its relation to the development of the topography, that we wish to see full test made of its sufficiency before we adopt it as an axiom.

According to the best light we have at present, we recognize that the Ozark area was uplifted in late Cambrian times and remained above water level, in part at least, probably until the carboniferous period; that, if entirely submerged during the Mississippian epoch, it was so only long enough to receive but a

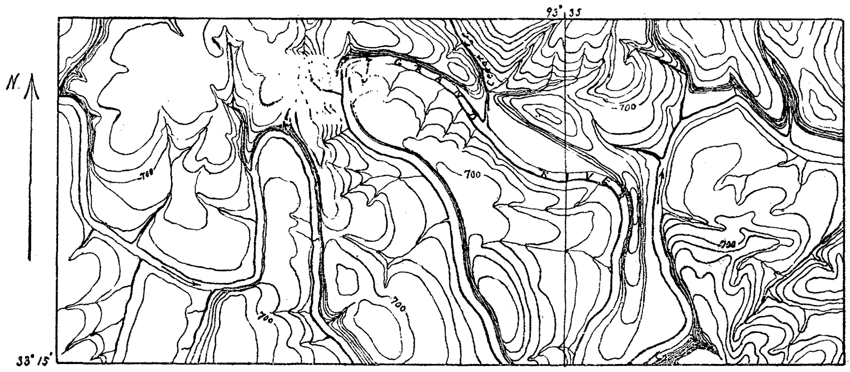
[1] "Report on Iron Ores," vol. ii, p. 89.

thin covering of the rocks of that formation; that these rocks were subjected to subareal erosion before and probably during the Pennsylvanian epoch and that coal-measure strata probably never covered the dome of the uplift; that since this time the region has been continuously above water level. According to this record the sculpturing of the topography must have been uninterruptedly in progress from the end of the Paleozoic to the present time.

Professor Davis sees evidence in the character of the relief that denudation progressed to such a degree that the present upland was a lowland—"well into Tertiary time, and that the new trenches of the Osage and its neighbors were begun in consequence of an uplift somewhere about the close of Tertiary time"—as opposed to this conclusion we have the fact that the Ozark plateau is at present much above the limits which we recognize Tertiary seas to have reached. The altitude of the Tertiary margin of the Mississippi embayment in southeastern Missouri is under 400 feet A. T. The summit of the Ozarks is, however, as much as 1,700 feet above sea level and the greater portion of the upland is over 1,000 feet, and was consequently at least 600 feet above the Tertiary sea level. Could a country having this altitude above contiguous seas be in a base-leveled condition? Further, another fact to reconcile with this hypothesis is the finding of certain chert gravels fringing the Osage and other valleys of the Ozarks, not very high above the present channels of the streams, which we provisionally correlate with the Orange sands of the Mississippi, of probable late Tertiary age. These imply the existence of such valleys with approximately their present phases in late Tertiary times. Still, as the correlation of these gravels is as yet confessedly quite hypothetical, this consideration cannot claim much weight.

Another hypothesis which has been thought by us to suggest an explanation of the sinuosities of these streams, has gained some strength through the observations of a recent boat trip down the Osage River, from Osceola to its mouth. If we take the case of a stream with a slightly sinuous course and of considerable declivity, moderately incised in a nearly flat, or even in an undulating country of horizontal strata—such as might exist in a newly emerged land surface soon after its emergence—we can understand that meanders will tend to develop somewhat as they do in the alluvial plain of a stream which has reached base level. Where the current impinges sapping will increase the convexity and the sinuosities will become more pronounced Inasmuch, however, as the declivity of the stream is great, corrosion is still active and the channel thus sinks vertically at the same time that it moves laterally, and in this respect its development will differ from that of a channel in a base-leveled alluvial plain. As a natural result of this process we can see how the stream will eventually shape for itself a tortuous and steep-sided valley, with very narrow flood plains until the channel has reached base level, when corrosion will cease and lateral degradation will increase; then, swinging from bluff to bluff in a secondary system of sinuosities, the stream will sap its bordering hills and widen its flood plains. If this explanation be a true one we should expect certain peculiar features of topography to prevail. Thus, with a stream not yet at base level we should look for its channel to constantly hug the hill on that side of the stream which is impinged by the current; here we should expect to find bluffs developed and maintained; conversely, on the "lee" side of the stream, we should expect to find such flat alluvial plains as exist, with comparatively gentle slopes thence to the uplands. Further we should expect to find the points or promontories of uplands which are nearly surrounded by the loops of the river, sloping somewhat gradually towards their ends and not terminating in bluffs. These features are pronounced, in part at least, to a striking degree along the Osage. They are details which could not be brought out on the maps of the scale of those thus far made of the Osage country, but the constancy with which the stream clung to the bluffs on the impinging side was impressively seen during the recent trip along that river, while the form of the projecting uplands is well illustrated by the following copy of a portion of a map of Grand River, one of the tributaries of the Osage, recently surveyed by Mr. C. F. Marbut, of the Missouri Geological Survey. On the hypothesis advanced the precipitous slopes characterizing the upstream sides of the hills here shown are the result of the sapping action of the stream; the gradual slopes of the downstream sides are primarily a combined result of the lateral movement of the channel accompanying the expansion of the meanders, and of its downward movement by corrosion.

It is true that similar features would result with the trench of previously developed meanders in the manner suggested by Professor Davis; for we cannot conceive of a meandering channel sinking absolutely vertically. Lateral degradation and movement must always accompany corrosion and vertical lowering of the channel; if the meanders existed originally their shapes must have been modified to the present forms. Hence the effects cited would seem to be attributable to one of two causes, or to both combined. The question is whether one is not all sufficient; whether a previous base-leveled condition is a necessary assumption.



Scale, 1 mile to 1 inch. *Contour-interval, 20 feet.*

MEANDERS OF GRAND RIVER, A TRIBUTARY OF THE OSAGE.

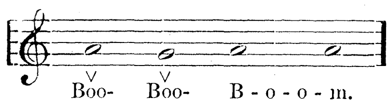
THE BOOM OF THE PRAIRIE CHICKEN.

BY T. A. BEREMAN, MOUNT PLEASANT, IOWA.

How many of your readers ever saw a prairie hen, or, as they are commonly called in the west, the "prairie chicken?" Doubtless many have seen dead ones, killed and shipped for the market, but I dare say that many of your younger readers, especially those living in the cities and towns, have rarely seen a live one. In 1845, when I came to Iowa, and for several years afterwards, they could be seen here in flocks of thousands together. But now there are only a few remnants of them left; here and there, in isolated fields, some dozen or two survivals have been permitted to remain. They are what is called the pinnated grouse of North America, and were formerly inhabitants of New Jersey, Pennsylvania and Kentucky, and all the western prairie country.

But at present I only desire to call attention to the matinee songs of this wild bird of the prairie. Some morning in the

month of April, when the sun rises clear and the air is crisp and frosty, go out upon the suburbs of a prairie town, away from the usual noises of the village, and listen. In a few seconds, if you can recognize the sound, you will hear, above everything else, the male birds go "boom, boom, boom." This is not a sharp, shrill cry, but a round, full, detonating cannon-like sound, which may be heard at long distances. It comprises three clear, distinct musical notes, corresponding with the "do, si, do" of the diatonic scale. The first two are quarter notes, and the last is drawn out to a full note, and even a prolongation of that. Probably some idea of it could be had from this representation:



This "booming" may be heard every spring along in March and April, and sometimes till May on clear frosty mornings about sunrise and for an hour or two afterwards; and for that reason I have sometimes from my own fancy called them "sun worshippers." It is worth an hour's walk to go out and see these birds when engaged in their booming orizons. As I have heard thousands of them booming at one time along in the forties and fifties, and have cautiously crept up to within a few yards of them when they were in plain view, let me try and describe them if possible.

The males have two neck tufts of feathers, two or three inches long, one behind each ear, and ordinarily they lie down close to the neck. Also on the sides of the neck and extending about two-thirds of the length of it, are two bare patches of skin capable of being inflated with air until they show out on either side as large as a small orange, and are nearly the color of an orange. Now, the proceeding is something like this: The bird stands unconcernedly among his companions for a minute or so, and then suddenly he spreads his tail to its fullest extent like a fan; his wings are spread and thrust down to the ground similar to a turkey gobbler's action; he walks around and about, rubbing his wing feathers upon the ground, his feet go patting alternately so rapidly you cannot count the motions, his head and neck thrust forward horizontally, the two tufts of feathers are erected like two great horns, the bare skins on the sides of the neck are inflated and then comes "boom, boom, b—o—o—m." This is repeated every few minutes for one or two hours in the morning, when no more is heard until near sundown in the evening.

A SILK-SPINNING CAVE LARVA.

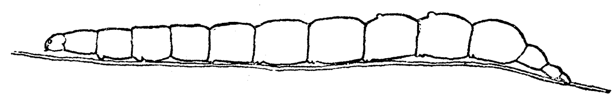
BY H. GARMAN, LEXINGTON, KENTUCKY.

In the Bulletin of the Essex Institute, Vol. XIII., 1891, I described a singular larva from Mammoth Cave, which was compared with larvæ of the Dipterous genera Sciara and Chironomus, to which it bears some resemblance. Since this larva was discovered a lookout has been kept for other specimens in hope of learning something of the adult, but thus far no additional examples have been seen. My search has been rewarded, however, by the discovery of a second larva, very different from the first but in its way almost as strange. Evidently it is a related insect. I take it to be the young of some cave-inhabiting fly.

Large examples measure 12.5 millimetres in length by 1 millimetre in greatest diameter. The body is composed of twelve somites behind the head, very distinct from each other and gradually increasing in diameter from the first to the seventh, after which they remain constant to the twelfth, which is only about one-half the length of the preceding somite and not more than one-fourth its size. The head is very small, and is enclosed in a smooth and shining crust of a pale yellowish brown color. The body terminates in a double finger-like clasping organ.

On a visit to a small cave near Lexington, Kentucky, some months ago my eye was caught by a glistening thread on the limestone forming the side wall of the cavity, about four feet from the floor. Thinking it was the trail left by a spider, I began to follow it carefully, expecting by this means to come upon the insect. Instead of a spider this larva was found,—a translucent slender thing which might easily have been overlooked even when one was engaged in following the thread upon which it lived. A touch was sufficient to put it in motion, then a touch at the opposite extremity would cause it to move backward with equal address. But nothing would induce it to leave the thread, and I have since learned that the heat from a burning candle applied to its body and destroying its life leaves it clinging to this fragile object. Not even spiders show such tenacity in retaining possession of their egg-cases, or webs, when in danger, and I infer that the welfare of this larva is intimately associated in some way with the silken path it makes along the face of the rocks. The thread is always accupied by a single individual, and may be a foot or more in length. I have found no examples nearer the floor than three feet.

The larva clings to its thread by means of pads provided with very minute chitinous asperities. One such pad occurs at the anterior ventral margin of the second, and another in the same position on the third, som te. These form rather large transverse rounded folds of the skin, covered posteriorly with dark denticles in numerous short series. The fourth somite lacks the pad, but on the ventral side and anterior margin of each of the succeeding divisions is a pad of another form, these being broader but not extending so far up the sides. When creeping an undulatory motion passes along the body, the pads dragging it forward, the posterior appendage apparently aiding by seizing the thread.



The details of structure have not been thoroughly worked out. In a general way the head is like that of the larva described in the Bulletin in 1891, but the large ocellus-like smooth areas of the Mammoth Cave larva are not present in this, although I find smaller oval areas surrounded by black rims and accompanied by pigment spots, which appear to represent these structures. The mouth parts are much like those of larval Sciara. The palpi which project from the under side of the head spring from the maxillæ. In very young examples I can make out large ducts which convey a secretion of some kind (doubtless the material of which the silken fiber is composed) to the under side of the head. No outward trace of respiratory organs is apparent. Four dark-brown Malpighian tubules can be seen, through the body-wall, opening independently into the intestine.

On the dorsal middle line near the anterior margin of each of the somites 8 and 9 is a turret-shaped prominence, the nature of which I have not determined. The top is sometimes a trifle impressed as if there were an opening to a gland beneath the skin. They can not be stigmatal prominences, for these are always paired. A study of sections may yield an explanation of them.

The habit of living upon the side walls of the cave is probably a means of avoiding enemies. Few of the predaceous cave species would find the larvæ there. The only available food would seem to be occasional tallow drippings and the molds growing on them.

Silk spinning is not general among Dipterous larvæ, but the cave species is not peculiar in this regard. I suspect that the Mammoth Cave larva produces a thread also. Among ordinary Diptera the clover midge (*Cecidomyia trifolii*) occurs to me at this moment as an example of species which produce material in the nature of silk. It envelops itself in a rather tough papery cocoon when ready for pupation.

A VERY bright comet has suddenly appeared in the western sky, and is attracting attention from the unexpected manner in which it has presented itself. The object from present accounts was first seen on the 8th inst., by persons living in Utah and Wyoming. It is very bright, about of the second or third magnitude, and has a tail that has been reported to be from five to twelve degrees in length. The comet is moving very rapidly to the east, and the only orbit at hand, at present, indicates that it is now passing away from the earth and will diminish very rapidly in brightness.

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A NEW ORTHOGRAPHY.

BY J. I. D. HINDS, CUMBERLAND UNIVERSITY, LEBANON, TENN.

THE orthography of the English language is distressingly bad. A reform in spelling would relieve education of one of its heaviest burdens. The hardest task of the first six years of the child's school-life is the spelling lesson. Indeed, the labor never ends. The veteran school teacher dares not venture too far from his dictionary. None of the phonetic systems which have been presented have met with such favor as to pass into general use. Yet reform must be possible.

In the phonetic systems now before the world there are two barriers to their general adoption. In the first place, the change from the present spelling is too great and too abrupt. The human race is like a heavy body in motion. Change of direction must be effected gradually. In the second place, the proposed systems are too complicated, and present distinctions which are too nice to be generally appreciated. To be acceptable, a system must possess two leading characteristics: (1) It must make the least possible departure from that now in use, and (2) it must be so simple that it may be read at sight and that the little child can learn it understandingly.

I think such a system is within our reach and that it might be brought into general use in a few years. I suggest the following:—

1. The present alphabet should be retained with as little change as possible. This is important, because new characters frighten the people and lay additional burdens on the printer. Besides, the language can be very well written with the characters which we have. The only deficiency is found with the vowels, and this can be supplied, as I shall show later.

2. Each character should have a fixed sound, and should retain the same sound in all its positions. In carrying out this rule, too much nicety must not be attempted. The vowel sounds are so variable that to represent all of them we should have to multiply characters almost indefinitely. We should thus have many words spelled differently in different positions and as coming from the mouths of different speakers. Every word should have a fixed form, and should retain this form in all its positions, though its pronunciation should vary. The written word is the symbol of an idea, and, at best, but approximately represents the spoken word. What we want is a compromise between the two which will do the least violence to pronunciation and afford the greatest ease in spelling. The mind tolerates a certain amount of ambiguity rather than endure too nice distinctions. This is illustrated in the varying sounds of the vowels as now used. Again, obscure sounds cannot be well represented phonetically. In syllables where they occur the vowel indicated by the etymology of the word should be retained.

3. Words should be spelled as they are pronounced, and each sound should be represented by its proper character wherever it occurs. Here, as before, too much nicety must not be attempted. Let us have a judicious compromise. The great difficulty of English spelling does not depend upon the fact that each of the vowels has several sounds. It is rather because each of these sounds is represented, not only by the other vowels, but also by a wonderful variety of combinations of vowels and consonants. For example, the long sound of *a* is indicated in at least twenty different ways, as in the following words: B*a*ss, f*a*te, p*ai*n, p*ay*, d*ah*lia, v*ei*n, th*ey*, gr*ea*t, *eh*, g*oa*l, g*au*ge, champ*a*gne, camp*aig*n, str*aigh*t, f*eig*n, *eigh*t, *aye*, ob*eye*d, w*eigh*ed, h*alf*penny. So there are twenty-four combinations expressing the long sound of *e*, twenty-six for the sound of *a* in all, among which are *augh* in aught, *ough* in thought, and *augha* in Vaughan; and for the sound of short unaccented *a* Miss Soames finds no less than thirty-four letters and combinations. No wonder the child, when learning to spell, is ready to give up in despair.

Now all that is very desirable can be attained through our present alphabet by giving to each letter a fixed sound and supplying a few vowel sounds by the use of double letters. The names of the letters should be so changed as to give to each vowel and vowel combination the sound which it represents and to make the names of the consonants uniform. We will take the five vowels and give them the names which they have in the European languages, and let them, when written singly, represent the short sound of these vowels. Let the long sounds be indicated by doubling or adding the letter *e*. For the diphthongs retain the ordinary combinations. The vowel system will then stand as follows:—

Vowels.

Long.	*Intermediate.*	*Short.*
aa, as in father,	*a*, as in last,	*a*, as in mat,
ae, as in mate,		*e*, as in net,
ie, as in machine,		*i*, as in nit,
oe, as in note,		*o*, as in not,
ue, as in rule,	*oo*, as in foot, bull,	*u*, as in up.

Diphthongs.

ei, like *i* in pine,	*ai*, as in air,	*oi*, as in boil,
au, as in laud,	*ou*, as in house,	*yu*, as in you.

Examining this table, we see that the short vowels present no change from their present usage. The Italian *a* is expressed by doubling the letter. The long *a* really corresponds to short *e*, and there is a fitness, therefore, in representing it by *ae*. This is commonly done now, except that the *e* usually goes to the end of the syllable. The other long sounds are also appropriately indicated by adding *e*. The intermediate *a* is so little used that it hardly seems necessary to provide for it a separate character. Its sound is usually suggested by the consonants which follow it. The sound of *u* in bull is well represented by *oo*. The long *u* is really *yu*, and it is so indicated. The least satisfactory of all, perhaps, is the use of *ei* for the long sound of *i*. The combination *ai* would have been better, but this occurs now in so many words and its sound is so well fixed that it was not thought best to change it. As a compromise, the letter *I* may still be retained for the personal pronoun. When these double vowels are once in use, they will naturally, in the course of time, be combined into one character.

Since the short vowel sounds do not occur in accented, open syllables, the lengthening *e* may be omitted in these, and the spelling thus further simplified. As an additional compromise, the letters in such positions might retain their present sounds

With the consonants, we need have little trouble. We will obtain the name uniformly by adding to each letter and combination the long *a*. The sound being indicated by the name, it is not necessary to give sample words. With an approximate classification into surds and sonants, stops and continuants, they are as follows:—

Consonants.

p, pae,	*b*, bae,	*t*, tae,	*d*, dae,
f, fae,	*v*, vae,	*k*, kae,	*g*, gae,
c, cae (chae),	*j*, jae,	*th*, thae,	*dh*, dhae (they),
s, sae	*z*, zae,	*sh*, shae,	*zh*, zhae,
r, rae,	*l*, lae,	*m*, mae,	*n*, nae,
h, hae,	*y*, yae,	*w*, wae,	*hw*, hwae (whay).

In this table but few innovations will be observed. *c* is made equal to *ch; dh* and *zh* are used for the sonant *th* and *sh;* and *h* is placed where it belongs, before the *w* in the combination *wh*. The letters *q* and *x* are not needed, but may still be used to avoid the awkward *kw* and *ks*.

In teaching this alphabet to children, and in spelling, the two characters which represent the long vowels and diphthongs should be pronounced as one sound, and not separately.

The following extract will give an idea of the appearance of the printed page in this system:—

Soundz at Ievning.

Swiet waaz dhe sound, hwen oft, at ievning'z kloez,
Up yondur hil dhe villaj murmur roez.
Dhair, az I past with kairles steps and slo,
Dhe mingling noets kaem sofnd from belo;
Dhe swaen responsiv az dhe milk-maed sung,
Dhe sobur hurd dhat loed tu miet dher yung,
Dhe noizi gies dhat gabbld o'r dhe puel,
Dhe plaeful cildren just let lues from skuel,
Dhe waac-dog'z vois dhat baed dhe hwispring weind,
And dhe loud laaf dhat spoek dhe vaekant meind;—
Dhies aul in swiet konfyuzhun saut dhe shaed,
And fild iec pauz dhe neitingael hæd maed.

OLIVER GOLDSMITH.

My object in this paper is not to present a finished system, but to show that the spelling reform is practicable, and to suggest a modification of the alphabet which will bring the desired relief. The time and energy wasted by a child in learning to spell would, if otherwise employed, be sufficient to give him an ordinary education. Let us do something at once to relieve education of this great burden.

The plan here proposed has the following additional advantages:—

1. The printed and written pages have no very unfamiliar look.
2. Print and script are easily read at sight by one who sees them for the first time.
3. One can learn in a few minutes to write in this system.
4. Its adoption will make no existing books obsolete or useless except a few primary school books.
5. It will give no special offence to the philologist.
6. It will lead easily to a better and more philosophical phonetic system.

ELECTRICAL NOTES.

The displays of high-voltage electricity which formed so prominent a feature of the late electrical exhibition held in the Crystal Palace, are not absent from the present one, but neither the display of Professor Elihu Thomson nor that of the Westinghouse Company approach, so far as spectacular effect is concerned, the exhibitions of Messrs. Siemens and Mr. Swinburne at the Crystal Palace. These latter were truly magnificent displays. They were, however, produced by high potentials obtained in the ordinary way, by transforming up, and on this account the experiments of Professor Elihu Thomson possess much more interest from a scientific point of view. The method used by the latter, as most electricians are aware, consists of passing a very rapidly alternating current through a few turns of a coarse copper wire wound round a glass tube placed in oil. Close to the coarse wire primary is wound a secondary of finer wire, and in this a very high voltage is induced by the current in the primary. This secondary current is also of very high periodicity, and all the Spottiswood and Moulton effects can be produced with it.

Owing, probably, to the resonant qualities of the room in which the Westinghouse exhibition takes place the noise of the discharge produces a very disagreeable effect on the nerves, even of those accustomed to working with high-potential discharges, so much so that one cannot help wondering at times if the powerful surgings in the ether do not directly excite the nerves as a battery does. It is true that in most of the high-frequency experiments no such effect is observed, but this may be because the quantity of current is in general very small. Meantime the coat-tails of the spectators can be seen, as Rudyard Kipling would put it, "crawling with invidious apprehension."

One of the signs of the times is the exhibit of electrical heating and cooking apparatus shown by the Ansonia Electric Company in the gallery of the Electrical Building. Here we see all manner of utensils, baking ovens, gridirons, chafing dishes, saucepans, coffee pots, etc., all arranged so that by simply attaching a plug to an ordinary lighting circuit they are put in operation at once. The subject is such an important one that the writer has thought it best to go into it more in detail (*vide infra*). Meanwhile it may be mentioned that the exhibit is well worth a visit.

The new Helios arc lamp, exhibited by the same firm, will also attract attention. This may be said to be, perhaps, the first thoroughly successful arc lamp for alternating currents. It is almost absolutely noiseless, and almost absolutely steady, more so than most direct-current lamps. These results are accomplished by the use of a low potential and of especially soft carbons.

It will be remembered that some years ago Mr. Edison brought out the kinetoscope. In this instrument a combination was made of the well-known zootrope and the phonograph, so that at the same time that the motions of the moving object were seen, the accompanying sounds were heard. The apparatus was exhibited at some of the charitable entertainments in New York through the influence of Mrs. Edison, but since then comparatively little has been seen of it. It has now been more fully developed and forms a part of the Edison exhibit in the gallery of the Electrical Building.

Among the instrument-makers the exhibit of Messrs. Queen & Co. stands preëminent. Their display is on the ground floor near the entrance, and includes almost every kind of electrical instrument made. A number of new instruments have been lately brought out by the firm. First among these we may mention Professor Ryan's electrometer, for use in making alternating-current curves. This instrument, which has already been described in the electrical papers and has been in use for some time at Cornell, consists of an electrometer whose needle is charged through a very fine platinum or silver wire to the potential of the alternating current machine, at any part of its revolution, by means of the ordinary commutating device. So far it does not differ very greatly from the ordinary electrometer. It is a zero instrument, however, and is brought back to its original position by the action of a current in a surrounding coil of wire, which acts on a small magnet fastened to the electrometer needle. The instrument being once standardized, the potential can be found by measuring the current passed through the surrounding coil, and this, from the nature of the operation, is a very short process. While the instrument has been known for some time, this is the first occasion, we believe, that it has been placed on the market.

It is to be hoped that some firm will do the same for the dynamometer method of Dr. Duncan, which has been used with so much success at Johns Hopkins.

Another very fine instrument is the cylindrical bridge. It is a very mechanical piece of work, and looks as if it could be depended on. With the Carhart commutator, standard ratio coils, and one of the new Ayrton-D'Arsonval galvanometers the electrician has a most complete apparatus for the measurement of resistances to almost any degree of accuracy.

These latter instruments (the Ayrton-D'Arsonval galvanometers) will probably interest the electrician more than anything else in the line of measuring apparatus. With electrical railways running in every direction near one's laboratory, the path of whose earth returns varies from day to day, with every sprinkle of rain or difference of temperature, the use of an ordinary sensitive galvanometer has been entirely out of the question unless in the neighborhood of a very strict law and order society, when a little work might be done by getting up to the laboratory at some unearthly hour on a Sunday morning. For this reason the tangent galvanometer has faded from the scene, and is now only used as a means of illustrating certain principles of electricity, its place being taken by Lord Kelvin's balances. And now the Thomson galvanometer must go before these new instruments, for the difference in sensibility is so small that there is practically no advan-

tage in using the Thomson, even under the most favorable conditions, and under ordinary circumstances there is no comparison between them, the D'Arsonval type being absolutely unaffected by external magnetic disturbances. Moreover, a good Thomson costs at least $400, and an Ayrton-D'Arsonval only about $70.

Whether this form of galvanometer will be equally satisfactory when used for ballistic measurements does not, as yet, appear. There does not seem to be any reason why, with a good design and a containing tube of hard rubber instead of silver, it should not be perfectly satisfactory.

Several sets of improved portable testing instruments for measuring capacity and insulation of cables, etc., are worthy of attention. Full sets of the instruments of Lord Kelvin are also shown.

Another exhibit, which may well make an American feel proud of the work which is being done in this country, is the display of the Weston Instrument Company. True it is that Mr. Weston is an Englishman, but the perfection of the instruments is due, not only to Mr. Weston's ingenuity, but also, to a large extent, to American machine-shop practice. No other country can hope to compete with us until they learn to use the fine and accurate machine tools which fill the instrument shops here. The writer had the opportunity a short time ago of visiting some of the more celebrated European works for the making of electrical and physical instruments. There was not a universal grinder to be seen in them, and in only one was a modern milling machine to be found, and then but a single one. All the last touches were put on by hand, and the result may be seen in the instruments themselves, where every screw has to be marked, because no screw will fit accurately into any hole except the one it is made for, and no two parts of the same type of instrument are interchangeable. In Europe, all the fine work is done in the assembling, here the greater part is done before the instrument reaches the assembler's hands. Probably there is no instrument in the world whose mechanical make-up is so perfect as an ordinary Weston voltmeter. A number of new designs are shown, and the new laboratory standards are especially fine.

The long-looked-for manganin wire bridges have begun to appear, the smaller portable testing sets being now on exhibition. This manganin wire is, as the reader is probably aware, the invention of Mr. Weston, having been discovered by one of his assistants, Mr. John Kelly, while experimenting on that line. There are a number of varieties of this alloy, which is formed of different proportions of copper, nickel, and manganese. Some of these have a negative coefficient, others a slight positive one, and an intermediate class, no temperature coefficient at the ordinary temperatures of working. The researches of the German Government Standardizing Bureau have shown that the alloy is a permanent one, and that it is well adapted for use in standard resistances. It is understood that new bridges of the latest improved form, with four and five dials, are soon to be put on the market, made of this wire, and accurate to a small fraction of a per cent. Another new thing, soon to be put out, is the Weston cadmium standard cell. It is well known by those who have done work on solutions that the solubility of a number of the cadmium salts is the same at all temperatures within the ordinary range of working Also that there is a relation between the solubility and the voltage production of a solution. Mr. Weston has utilized this property of the cadmium salts to form a cell (of a similar nature to the ordinary Clark cell, but with cadmium substituted for the zinc and zinc salts), whose temperature coefficient is practically nil. It is claimed that considerable usage has shown that it is very reliable.

As regards the electrical fountains, there is little to be said of them in spite of the great secrecy in which they are wrapped by the officials in charge. The principle is the one generally used, i.e., the projection of a beam of light so as to strike the walls of the jets from the inside, and so be reflected up along the inside of the column of water. Some slight mechanical ingenuity has been exercised in the means of feeding the carbons of the electric arcs, otherwise there is little of interest in the mechanism itself. The display, however, is very pretty, and it may be worth while to give a hint as to the best means of seeing it, as follows: —

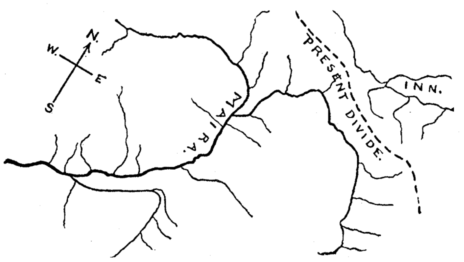
Take the electric launch at the wharf on the Liberal Arts side of the bridge connecting the Administration Building with the Liberal Arts Building, at about 8.30 or 8.15 in the evening (the exact time depending upon the time the electric fountains begin to play, the time of starting should be about 45 minutes before they begin). This will bring the launch back to the basin containing the fountains just about the time they are in full operation, and, as the boats make two turns round this lagoon, opportunity is afforded for a long view of the display. Moreover, the voyage around the other lagoons gives one a beautiful view of the grounds and buildings from the water. The illumination of buildings is well under way by that hour, and the long ride on the water is very enjoyable after the heat of the day. The writer has been informed by those who have had the opportunity of comparing the two, that even the most gorgeous sights of Venice do not enter into comparison with the view thus obtained. R. A. F.

A NEW INSTANCE OF STREAM CAPTURE.

BY HUNTER L. HARRIS, CAMBRIDGE, MASS.

The action of a rapidly flowing stream in cutting back into the drainage area of another, of less gradient, and, finally, capturing some of its headwaters, has been prettily described in the columns of this journal by Prof. W. M. Davis of Cambridge, under the name of "A River-Pirate." In this notice he describes an instance of such action occurring in eastern Pennsylvania, and alludes also to other instances, one of which is that occurring in the Upper Engadine of Switzerland.[1]

By keeping in mind the principles governing the cutting power of streams, we may easily picture to ourselves the conditions which would result from the excessive action of one stream over



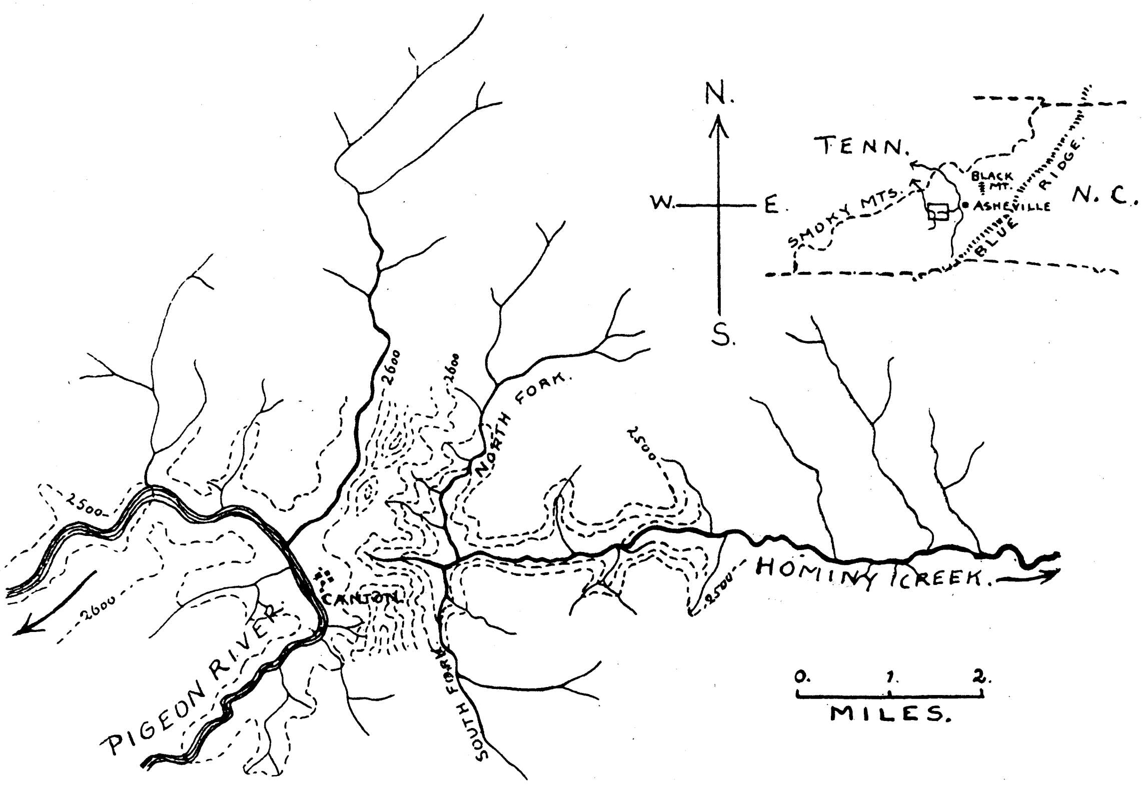
that of a near neighbor. Briefly, the more active stream, by virtue of its greater activity, would begin to enlarge its catchment basin, its headwaters eating their way gradually backward, and so pushing the divide farther and farther into the region formerly drained by the relatively weak stream. In process of time, the aggressive stream may actually tap some of its neighbor's headwater members, and, since the divide migrates unevenly, this tapping may occur either at the head, or at some point lower down on the invaded stream. If at the head, we may have a short inverted stream, which possesses few marks by which we may afterwards read its history. But if the connection takes place lower down, as is often the case, a peculiar back-set direction is given to the stolen tributaries which have been thus forced to discharge their waters through a new main stream of reverse direction. They may be compared to the barbs upon an arrow, the body of the arrow representing the pirate stream. This then constitutes a peculiarity by which we may easily recognize instances of such capture. But other evidence should be sought, such as the former comparative activity of the two principal streams, indications of the former course of the stolen tributaries, etc.

The case of the Upper Engadine mentioned above may be taken as typical. Here the aggressor is the Maira, flowing southwest, and it has not only taken a goodly part of the drainage area of the Inn, which has an opposite direction of flow, but has also appropriated at least three of its tributaries. The Maira is considerably more rapid, and hence more active, than the other. The accompanying sketch, taken directly from one of the maps of the Swiss official topographic survey, shows the characteristic form of the resultant drainage system.

[1] Vol. xiii., 1889, p. 108. See also R. de C. Ward, "Another River-Pirate," vol. xix., 1891, p. 7.

An instance of stream capture possessing all the "ear marks" of the typical case, is found in the Appalachian region of western North Carolina and within a few miles of Asheville. Among the principal streams traversing this elevated plateau region, are the Pigeon River and the French Broad, which take their rise on the broad back of the Blue Ridge, and, flowing westward, make their way through deep gorges in the Unaka Mountains, whence they descend into the broad, deep valley of eastern Tennessee. At one point, a northward turn of the Pigeon brings it within a dozen miles of the French Broad. Here, within half a mile of the former, and at an appreciably lower level, Hominy Creek takes it rise, and maintains a rapid, torrential course eastward, joining the French Broad at Asheville. A low and narrow divide separates this young and active stream from the slower moving Pigeon. Reckoning from this low divide, the fall of the smaller stream, within the first three miles, is more than three hundred feet, while an equal distance on Pigeon River yields a difference of level of only a little more than one hundred feet.

Here then are conditions favoring the lengthening of one stream



with loss of territory by the other, and such has clearly taken place. The accompanying map is traced from the topographic map of the region made by the U. S. Geological Survey (Asheville sheet). It will be at once noticed that the branching headwater tributaries of Hominy Creek, instead of flowing with an easterly course like those which enter lower down, have a distinctly back-set position like the barbs of an arrow. A visit to the region would leave little room for doubt that these were once tributary to Pigeon River. The arrangement of the contours shows, in fact, a depression which may mark their former course over what now constitutes the divide.

INSECTIVOROUS PLANTS OF SOUTH FLORIDA.

BY G. W. WEBSTER, LAKE HELEN, FLA.

As one approaches the moist grounds bordering on the lakes and ponds so numerous in south Florida, a beautiful plant is often found that, while it attracts the attention of the ordinary observor, is especially interesting to the student of natural history.

Its 10 to 25 leaves of a reddish color and semi-transparent texture are all radical, forming a tuft or rosette generally not more than two or three inches in diameter, from the centre of which during the months of April and May it sends up a single flower stalk or scape 6 to 10 inches high, and bearing at its summit a one-sided raceme of light rose-colored flowers 4 to 5 twelfths of an inch in diameter. Its oval seeds, when seen through a microscope, are finely furrowed and covered with small granules arranged with perfect regularity.

The spatulate leaves are narrowed into a long leafstalk or petiole, the wide portion less than one-half inch in length and one-half as wide.

It is known to botanists as *Drosera capillaris*, and has the usual characteristics of the order Droseraceæ.

The leaves are circinate in the bud, that is, rolled up from the apex towards the base, after the manner of ferns. The upper surface is covered with somewhat fleshy, reddish filaments less than one millimetre in length in the centre of the leaf and gradually increasing to the length of 4 or 5 millimetres on the border. These filaments or tentacles are about 200 in number on each leaf, and each bears at its summit a gland which secretes a drop of perfectly transparent, viscid substance that glitters in the sunlight like a brilliant dewdrop, hence the common name of sundew.

This secretion is very adhesive, and whenever any small insect attracted by the brilliant color of the plant, the prospect of a sip of dew or from any other cause, alights upon the plant, it immediately becomes entangled in the treacherous substance. The tentacles of the outer border of the leaf, which were before curved backward, now slowly but surely begin to curve inward, carrying the victim toward the centre of the leaf, and enfolding it closely from every side. At the same time the secretion from the glands is greatly increased, drowning or smothering the insect. The leaf also slowly assumes a more cup-like shape and rolls back from the apex toward the centre of the plant and finally holds its victim in a close embrace, with the 200 glands pressed down upon it, bathing it in their secretion, which has now changed to acid and become capable of dissolving and digesting the soluble parts. These are taken into the circulation

of the plant and by assimilation assist in its nourishment and growth.

When the work is completed, the leaf unfolds, the tentacles uncoil and again fold backward, leaving the skeleton of the insect in the centre of the leaf as a warning to all passing insects. A careful observation of the plants when in active growing condition will show all stages of the process. Some leaves will be folded up enclosing fresh insects, while many more will be seen spread open with the skeletons on their upper surface. Having finished their meal they are ready for the next customer. Occasionally the living insect will be found struggling to free itself from the adhesive secretion of the glands and the grasping tentacles that threaten its life. The larger insects often manage to free themselves and escape the fate that overtakes the less fortunate. I have seen the common house fly after being held for sometime finally extricate itself and fly away.

A great variety of insects, such as mosquitoes, small flies and bugs, become the victims of this carnivorous plant. Small spiders with their soft bodies seem to be especially adapted to supplying its demands.

The plant, which has but a few very small roots, can be easily transplanted to boxes where it can be more readily observed. A sufficient amount of the adhering soil should be taken up with it, which can be readily done by means of a common garden trowel.

In some experiments lately made I find that it generally takes from 24 to 48 hours for the leaf to become completely folded over an insect. Small house flies required in some instances 48 hours, and it was nearly two weeks before the leaf again unfolded. Small spiders, having softer bodies, were digested in less time. Small pieces of cooked beefsteak placed on the leaves at noon were enfolded by the next morning. At first the leaves appeared to be stimulated to extra activity, but the beef did not seem to be adapted to the sustenance of the plant. After a few days the leaves, instead of unfolding gradually wasted away, the tentacles withered and finally the whole leaf died, leaving the beef apparently but little changed. Pieces of wood or solid vegetable fibre placed on the leaves would be partly enfolded but only remain so for a day or two. Tender vegetable tissues in 48 hours were reduced to an apparently decomposed pulp.

Besides *Drosera capillaris* we have here in Volusia County two other species of Drosera; *D. brevifolia*, a smaller plant, not very common, grows in higher and dryer situations. The leaves are only about one-half inch in length, while the pretty flowers are quite conspicuous, being one-half inch in diameter.

D. longifolia is occasionally seen on swampy and overflowed lands, where it is found floating during high water, the few roots taking a feeble hold of the soil as the water recedes.

The Venus's fly-trap (*Dionœa muscipula*), also belonging to the order Droseracæa, I think has not been found so far south as Florida.

The spotted Trumpet Leaf (*Sarracenia variolaris*), also an insectivorous plant, is common here.

Bejaria racemosa, a shrub growing 2 or 5 feet high, with large and showy white flowers, secretes a viscid, sticky substance on the stems below the flowers, thus entrapping many insects. It is often called Fly Catcher.

It is the general law in vegetable physiology that plant life receives nourishment from two sources — First from the more solid organic and mineral substances supplying phosphorus, potassium, sulphur, ammonia, etc., taken up by the rootlets and carried in solution to every part of the plant to be utilized in the process of growth, and, second, from the gaseous substances, oxygen, carbon dioxide, nitrogen and ammonia, drawn from the atmosphere through the stomata of the leaves. In carnivorous plants alone do we find the power of dissolving and appropriating organic substances through the leaves. In this power there is an approach made toward the function of the stomach in animals, thus forming another connecting link between the vegetable kingdom and those forms of life so nearly on the dividing line between the animal and the vegetable that it is sometimes difficult to determine on which side they really belong, and demonstrating to the student of biology that there is a unity in all life.

QUANTITY AND QUALITY OF MILK.

BY W. W. COOKE, STATE AGRICULTURAL EXPERIMENT STATION, BURLINGTON, VT.

SEVERAL attempts have been made to measure the effect of the period of lactation of the cow on the quantity and quality of the milk. In nearly, if not all, of these cases no account is taken of the food or the conditions. In this note it is intended to show how these changes during the period of lactation are modified by the abundance or scarcity of the food of the cow.

Most of the cows of Vermont calve in the spring, from February to May. We have the records of twenty such herds of about twenty cows each. Averaging these records, we get figures based on the doings of over four hundred cows. Hence the results ought to be quite reliable.

All results are calculated to thirty days in a month.

	April.	May.	June.	July.	August.	September.	October.	November.
Average daily yield of milk per herd, pounds.......	242	313	403	365	300	261	210	114
Ratio of different months, if June is 100...............	60	75	100	87	72	64	50	26
Average per cent of fat in milk.......................	3.60	3.75	3.86	3.90	4.04	4.36	4.61	5.07
Ratio of different months, if June is 100............	93	97	100	101	104	112	119	131
Average daily yield of butter fat per herd, pounds	8.7	11.3	15.6	13.7	11.7	11.4	9.4	5.8
Ratio of different months, if June is 100..............	56	73	100	88	75	73	60	37

These cows were fed but little grain at the barn. They were turned to pasture in May and fed no grain while on pasture. As the pastures dried up in August and September, but little care was taken to keep up the flow of milk. Almost no grain was fed, and not much of fodder-corn or of fall mowings. When they came to the barn in November, no pains were taken, in most cases, to keep them along in milk. The feeding, then, may be said to be rather poor at the two ends of the season and an abundance of the best of feed in the middle.

Under these conditions there is a marked increase in the quantity of milk under better feed, reaching its height when the feed is best in June and skrinking still more markedly when cold weather and short feed occur in November. The changes in quality are especially worthy of note. There is a prevailing idea that when cows go out to grass the milk gets poorer in quality as it increases in volume. Some States recognize this belief in their statutes by lowering the legal milk standard during May and June. Many tests at this station during four consecutive seasons have shown the incorrectness of this belief, and the figures of these 400 cows show the same very conclusively.

The per cent of fat is lowest just after they calve, and there is a rapid increase when they go to pasture, and a continued increase each month until at the last the increase is very rapid.

It is to be noted, however, that this increase of fat per cent is not enough to counterbalance the decrease in the weight of the milk, so that the total daily fat decreases during the fall months in spite of the increased rickness of the milk.

If these records are compared with those of the station herd that have been full fed all the year, it will be seen that there are no such violent changes. When the cows go to pasture the milk increases quite a little, but the fat remains about the same, and for the first eight months of lactation there is only a slight change in per cent fat, and no very large decrease, and no sudden decrease in quantity of milk. Also, it will be noted that in our herd there is not so large an increase in per cent fat at the end of the period

of lactation. But few cows change one per cent from richest milk of last month before drying up to thinnest milk after calving.

The following is the record of six cows at the Experiment Station Farm that calved in the spring and were fed at the barn heavily with grain, hay, and ensilage, before and during pasturage, and also after their return to the barn until they dried up.

	April.	May.	June.	July.	August.	September.	October.	November.
Average monthly yield per cow, pounds............	792	867	918	814	723	711	531	340
Ratio of different months, if June is 100............	84	91	1 0	86	76	75	56	36
Average per cent of fat in milk....................	4.07	4.38	4.38	4.28	4.37	4 52	4.70	4.83
Ratio of different months, if June is 100..............	93	1 0	100	98	100	103	107	110
Average monthly yield of butter-fat per cow, lbs...	32.2	38.0	41.5	35.8	31.6	32.1	25.0	16.4
Ratio of different months, if June is 100..............	78	91	100	84	76	77	60	40

The influence of full feeding is seen most strongly during the months of April and May, which yield, with grain, one-third more milk and butter-fat than without. An influence after June is seen, but not so pronounced. Those having grain shrink in milk-flow only nine-tenths as fast as those not having grain, and have the advantage of only one-twenty-fifth in the shrinkage of butter-fat.

Of course, this is not a strict comparison of the effects of feeding grain on the total yield or of the financial side of the question, but merely of the effect the grain has of increasing the flow of the milk at once when the cow calves and of maintaining the milk-flow for a longer period in the latter part of lactation.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

An Unusual Aurora.

ON Saturday evening, July 15, there occurred an aurora which was unlike any the writer has ever seen, and a brief description of it may contribute something to the aggregate knowledge of those interesting phenomena.

The peculiar feature of this aurora was the movement of a series or succession of whitish flecks across the sky from east to west, resembling somewhat the waves of a body of water.

About 9.30, central time, my attention was first attracted to it. Flecks of white light were forming in the east at an altitude of about 45°, passing in regular succession westward, about 20° north of the zenith, and apparently accumulating in one larger band in the northwest, reaching at times from near the horizon to perhaps 80°. The white flecks or streaks were about 10° in length, strictly parallel north and south, and quite uniform in distance apart. They grew brighter and more distinct as they approached and passed the meridian. Their motion was very regular and quite rapid,—comparable to the swiftest apparent motion of light clouds. If they were as high as the electric theory would suggest, the velocity must have been enormous.

At times similar short bands, like strokes with a paint-brush, were stationary in the north, at about 45° altitude, for several minutes at a time.

A few minutes later a number, perhaps ten or twelve, white bands appeared north of the zenith, all converging towards a point some 10° south of the zenith, but vanishing before reaching the zenith. They remained only a few minutes. About 10 o'clock the moving flecks had disappeared, and one long, straight band extended from the northwest horizon, 50° or 60°, toward a point about 45° south of the zenith. Two or three other short flecks appeared parallel with the main band. About the same time the usual diffused glow appeared in the north horizon and continued till after 11 o'clock, but was not observable while the moving bands were seen. Many more gorgeous auroras have been seen in our latitude, but the rapidly-moving bands gave this one a new interest.

W. H. HOWARD.

Adrian, Mich.

Light-Shunners and Light-Seekers.

It is well known that in the main divisions of the animal world we find groups which normally withdraw from daylight and which form a very large minority of existing species. Some of these lovers of darkness dwell in caverns, in underground burrows or in the seas at depths where the light penetrates feebly or not at all.

We might, perhaps, expect that such creatures would feel annoyed, more or less, by artificial light and would withdraw from what to them must be an exceptional phenomenon. This, however, would be a mistake. The only nocturnal animals which seem to shun fire and light are the carnivorous mammals especially the cats. It has long been customary for travellers in Africa to keep lions, leopards, etc., aloof from an encampment by means of bonfires. As a rule the sleepers are safe as long as the fires are fed up.

The lemurs and loris are even more nocturnal than the cats, since they do not travel or prey by day. Whether they are repelled or attracted by a light is not sufficiently decided.

The bats are not purely nocturnal. They are sometimes seen hawking for insects in full daylight. But a light attracts them. Entomologists — I may mention Major Elwes, P. E. S. — who have hung out lamps in order to entice moths, have often found that bats come to the lights and secure a large share of the specimens.

Among birds there are few truly nocturnal species. The owl and the night-jar (absurdly called the goat-sucker) are the most common night fliers. The owls are attracted by a light, a fact which has given rise to a foolish superstition. They will often dash against the window of a room which is lighted up by night. If, as often happens to be the case, this is a sick-chamber, nurses of the old school pronounce such a visit a fatal omen. Some would-be wise men have gravely asserted that the owl scents the approach of dissolution and comes in the hope of feasting upon the corpse. Now, in fact, the owl feeds by preference on prey which it has just killed, and in captivity it rejects any food which is in the slightest degree tainted.

In Australia the emur, though not truly nocturnal, may be seen rapidly scudding over the plains by moonlight.

Many birds which are perfectly diurnal, in their ordinary habits, fly by night when migrating, and are then attracted by a light. Numbers of various species dash themselves against the windows of lighthouses and are killed by the shock. This is much to be regretted, since the majority of migratory birds feed on insects, and had they survived they would during the coming season have been hard at work ridding our crops of vermin.

The habits of reptiles vary greatly. The few European snakes, e.g., the viper, the asp, the Austrian adder, the grass snake and *Coronella lævis*, are rarely met with save in the brightest hours of the day. But of the African, Indian and Australian species it may be said:

"The snake that loves the twilight has come out, beautiful, still and deadly"—though they also bask in the sun. Nor are they scared away by lights or fire. One species, indeed, if it espies a fire in the forest, seeks to dash or drag the sticks away. Toads, newts and salamanders live very contentedly in the dark, but seem to regard a light with indifference.

The majority of fishes and other dwellers in the waters are decidedly attracted by lights.

It is well known in various countries that fishes swim up to a boat on a stream if a light is displayed on board.

An interesting spectacle is produced if a candle, or better still an electric glow lamp is brought near the glass sides of an aquarium. Fishes, aquatic larvæ and mullusca swim up and seek to come as near as possible to the light.

Numbers of nocturnal insects are attracted by flame. Moths, gnats, crane-flies and many other diptera are noted for their propensity to commit suicide in our lamps and candles. Many of the smaller moths are found sitting on the glasses or the iron frame-work of street-lamps. I have known an old lady made ill with fright because a death's-head (*Acherontia atropos*) had flown against her candle and put it out.

But we must now glance at the main question, that is, the meaning of the behavior of nocturnal animals in presence of a light. The alarm of many species is not hard to understand. A bright light is a phenomenon which does not fall within the limits of their experience and seems to them, therefore something to be avoided. But to see nocturnal, abysmal or cave-dwelling species flocking to a light is perplexing.

It has been suggested that the moth thinks the flame an outlet through which it may escape. But why should it seek to escape from a condition which to it is as normal as is sunlight to the butterfly or to the bee? It has again been suggested that nocturnal insects and fishes are able to preceive the faint phosphorescent light apparently given off by many flowers, and by aquatic worms, etc. Hence the moth rushes to the lamp mistaking it for a flower. On coming nearer he is bewildered by the intensity of the light and "loses his head." This same supposition explains why mosquitoes are less attracted by a lamp than are most other insects. They are not accustomed to find their food in phosphorescent flowers, hence the lamp has to them little attraction.

True, this hypothesis fails to show why birds should dash themselves against the windows of a lighthouse. Their normal food is not phosphorescent. Nor, to our knowledge, are their eyes capable of perceiving a faint phosphorescent light.

Probably no single hypothesis will meet all the cases of the attraction of animals to light. J. W. SLATER.

London, England.

The Aurora.

The contradiction in certain statements of mine with reference to the possibility of tracing the relation of the aurora to disturbances upon a particular part of the sun in certain years which Professor Ashe thinks he has detected and which he puts into italics at page 9 of *Science* for July 7 amounts to simply this: In one sentence which he quotes I am giving the reason why the relation in question comes out distinctly in years of minimum, namely, because the disturbances are well separated from each other, and, taking 1879 as an example, show by a table that this was the case in that year, in which both auroras and sunspots were so very few that the numbers to be employed were so extremely small that it might justly be doubted whether they show anything, and yet, in spite of this disadvantage, namely, the smallness of the numbers, the relation was plainly apparent. In another sentence, referring to the matter from this point of view, namely, the size of the numbers to be employed, I state that in 1880 the relation in this respect would be much more distinct, this also being a year of comparative minimum in which the disturbances were well separated from each other, so that the conclusion with reference to this year contained in the sentence which Professor Asche quotes would be fully justified, i.e., "the numbers would be larger and the relation in every way more distinct." The only reason for the publication of the table for 1879 was to show what would appear in the year in which we might suppose the relation exceptionally difficult to trace and yet in which it was distinctly apparent in spite of the smallness of the numbers. It was simply picking out the worst possible case, as we would naturally suppose, instead of the best possible case, and it is to its discussion that the sentences which Professor Ashe quotes, refer. M. A. VEEDER.

Lyons, N. Y., July 13.

Natural Selection at Fault.

I AM truly sorry if, in my remarks on this subject, I have failed to make myself understood. As regards the common cat, I have seen not merely half-grown kittens, but middle-aged mousers, play with their booty and lose it.

The idea of this practice having the object of cultivating agility seems to me exceedingly far-fetched.

I have not sought to account for the cackle of hens, but have merely pointed out the undeniable fact that it is very liable to attract the attention of any ovivorous bird or beast to the probable presence of an egg.

The rarity in man of the power to erect the ear, or to turn it so as to catch any faint sound-waves has been repeatedly noticed, as also the fact that it does not collect all the impinging sound-waves into the orifice of the ear. My only merit, or demerit (?), has been to cite the abated condition of the ear-muscles as an instance of natural selection at fault. The ear is probably in a state of transition, but in what direction? J. W. SLATER.

London, England, April, 25.

The Habitat and the Diet of the Lepidoptera.

A FEW lepidopterous species select in different countries widely different habitats and food plants. Thus *Papilio machaon*, the most common European species of papilio, is confined in England to the fenny districts of Cambridgeshire, and occasionally extends to small portions of the adjoining counties. What with the greediness of collectors for "British specimens" of any remarkable insects, and with the drainage of the fields, it is feared that this species will soon be extirpated. The caterpillar of this species, in England, feeds on swamp plants.

In central Europe *Papilio machaon* is fairly abundant on the dry, gravelly hills and certain parts of lower Silesia, Bohemia and Saxony, the very opposite in their character to the fields of Cambridgeshire. The larva in Silesia and Bohemia feeds frequently on the mountain ash.

The three hawk moths, *Chanocampa celerio*, *Ch. elpenar* and *Ch. porcellus*, on the European continent, feed chiefly upon the vine. But in England they feed on bed straw, willow herb and sometimes on the fuchsia. I have in vain tried to induce larvæ of elpenar or porcellus to feed on vine leaves, probably if the ova had been placed upon vine leaves the young larvæ would have not refused this, their normal food. J. W. SLATER.

London.

Beaver Creek Meteorite.

Between the hours of 3 and 4 P. M. on the 26th of May last, a meteorite was heard by many persons, and three of the fragments were seen to fall near Beaver Creek, West Kootenai District, B. C., a few miles north of the United States boundary.

The two smaller of these fragments, weighing perhaps 5 to 6 pounds in all, were picked up at once; the larger one, weighing about 25 pounds, was not found until the next morning. It made a hole in the wet earth about three feet deep, two feet in soil and one foot in hard pan. The direction of the hole was south 60° east, true meridian, and at an angle of 58° with the horizon.

Fresh earth was scattered about the hole in all directions, but farthest (10 feet) in the direction from which the stone came.

On the 6th inst. I saw and purchased this stone from Mr. James Hislop, a civil engineer, who found it and brought it to Washington.

It is a typical aërolite of very pronounced chondritic structure. It is completely coated with the usual black crust, except at one end, where about three pounds have been broken off and scattered, like the two smaller stones, mostly among mere curiosity hunters. The mass now weighs 22½ pounds, measures 6 × 7½ × 9½ inches, and approaches in shape an acute octahedron.

I propose for it the name of *Beaver Creek*, from the stream by the banks of which it fell.

A microscopical examination and chemical analysis will be made soon. EDWIN E. HOWELL.

Washington, D.C.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange.—A complete set of the report of the last Geological Survey of Wisconsin, T. C. Chamberlin, geologist. It consists of four large volumes, finely illustrated, and upwards of forty large maps and charts. Will sell for cash or exchange for a microscope. Address Geo. Beck, Platteville, Wis.

For sale or exchange for copper coins or rare postage stamps. Tryon's American Marine Conchology, containing hand colored figures of all the shells of the Atlantic coast of the United States. Presentation copy, autograph, etc. One vol., half morocco, 8vo, usual price, $25, postpaid, $15. Botany of the Fortieth Parallel of the Hundredth Meridian of the Pacific R. R. Survey. Other Botanical works and works on Ethnology. F. A. Hassler, M.D., Santa Ana, Cal.

I have a fire-proof safe, weight 1,150 pounds, which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

For exchange.—Hudson River fossils in good condition from the vicinity of Moore's Hill, Ind., also land and fresh water shells. Desire fossils and shells from other groups and localities. Address Geo. C. Hubbard, Moore's Hill, Ind.

For sale at low price.—A fine old-fashioned photographic camera, rosewood box, one foot square, lenses, four inches diameter, made by C. C. Harrison. Plateholders, troughs, baths, etc., all in large wooden case, formerly the property of the late President Moore, of Columbia College. This is a fine example of an instrument of the best make for the old wet-process methods, and valuable to any institution or amateur interested in the history of photography in the U. S. Address M. S. Daniel, 236 W. 4th St., New York.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

For exchange.—I wish to exchange Lepidoptera of South Dakota and other sections, for Lepidoptera of the world. Will purchase species of North America. Correspondence solicited, particularly with collectors in the Rocky Mountains, Pacific coast and Hudson's Bay regions. P. C. Truman, Volga, Brooking county, South Dakota.

Wants.

A YOUNG man who has been through the course in mathematics in Princeton University, wishes some tutoring this summer. Rates reasonable. Address P. H Westcott, Cramer's Hill, Camden Co., N. J.

A GRADUATE of an American Polytechnic institution and of a German universit (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry, Address Chemist, 7.7 Cary St Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

A ZOOLOGICAL collector and taxidermist of ten years' experience in the field is now open to engagement, for either field or laboratory work. References furnished. Address Taxidermist, Box 75, White Sulphur Springs, West Va.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi*, *cyrtonyx montezumae*, *deudragapus franklini*, *lagopus welchi*, *tympanuchus cupido* and *pedioecetes phasianellus*. Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3922 Fifth Avenue, Pittsburgh, Pa.